

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

NUMBER: M8-1SS-BM006-X
 (DOESNT APPLY TO PMA2/3
 PASSIVE MECHANISM)

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 1 DEC, 1996

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: GUIDE RING ASSEMBLY RSC-ENERGIA	33U.6271.011-09(SOFT) 33U.6271.011-05 (PMA1)
SRU	: ASSEMBLY, CAPTURE LATCH RSC-ENERGIA	33U.6322.025 33U.6322.025

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
 CAPTURE LATCH ASSEMBLY

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 3
 THREE (ONE PER GUIDE PEDAL)

FUNCTION:

THREE ACTIVE (CAPTURE) LATCHES, ONE ON EACH GUIDE PEDAL OF THE ORBITER DOCKING RING. PROVIDES POSITIVE CAPTURE TO THREE PASSIVE (BODY MOUNTED) LATCHES LOCATED ON THE ISS DOCKING MECHANISM. CAPTURE LATCH ROLLER MECHANISMS MOVE ASIDE DURING CLOSING CONTACT WITH THEIR OPPOSING BODY MOUNTED LATCHES AND ARE SPRING DRIVEN TO LOCK AFTER PASSING THE THREE PASSIVE BODY LATCHES (LUGS). TWO ROLLER MECHANISMS LOCATED ON EACH CAPTURE LATCH ASSEMBLY PROVIDE A REDUNDANT MEANS OF CAPTURE.

UPON RECEIPT OF A "CLOSE CAPTURE LATCH" COMMAND, POWER IS APPLIED THROUGH REDUNDANT "LATCH MOTOR OPEN" SENSOR CONTACT SETS TO A SINGLE ACTUATOR MOTOR TO EXTEND BOTH ROLLERS OF ONE CAPTURE LATCH ASSEMBLY. A "LATCH INDICATION CLOSED" SENSOR ON EACH ACTUATOR SENSES THE CLOSED POSITION OF THE LATCH AND SENDS REDUNDANT SIGNALS TO THE DOCKING CONTROL PANEL VIA THE DSCU TO ILLUMINATE THE "LATCHES CLOSED" LIGHT WHEN ALL THREE CAPTURE LATCHES ARE CLOSED.

UPON RECEIPT OF AN "OPEN CAPTURE LATCH" COMMAND (FOLLOWING COMPLETION OF THE DOCKING PROCESS), POWER IS APPLIED THROUGH REDUNDANT "LATCH MOTOR CLOSED" SENSOR CONTACT SETS TO A SINGLE ACTUATOR MOTOR TO RETRACT BOTH ROLLERS OF THE CAPTURE LATCH ASSEMBLY FOR UNDOCKING OF THE ISS AND ORBITER (NOMINAL UNDOCKING IS NOT PLANNED TO PMA1 MECHANISM). A "LATCH INDICATION OPEN" SENSOR LOCATED ON EACH CAPTURE LATCH ACTUATOR SENSES THE OPEN POSITION OF THE LATCH AND SENDS REDUNDANT SIGNALS TO THE DSCU TO ILLUMINATE THE "LATCHES OPEN" INDICATOR LIGHT ON THE DOCKING

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CONTROL PANEL AND COMMAND RING TO RETRACT WHEN THE SENSOR ON ALL THREE CAPTURE LATCH ACTUATORS IS CLOSED.

THE THIRD CONTACT SET OF EACH "LATCH INDICATION OPEN" AND "LATCH INDICATION CLOSED" SENSOR IS UTILIZED FOR GROUND MONITORING OF CAPTURE LATCH POSITION. CAPTURE LATCH "INITIAL POSITION" IS ALSO DOWNLINKED FOR GROUND MONITORING.

IN THE EVENT A CAPTURE LATCH FAILS TO OPEN, THE MANUAL LATCH/UNBLOCKING DEVICE CONTAINED BEHIND THE CAPTURE LATCH ASSEMBLY WILL PROVIDE MANUAL RELEASE OF THE LATCH. A BUTTON ON EACH SIDE OF THE DEVICE, WHEN DEPRESSED SIMULTANEOUSLY, WILL RELEASE LATCH CONTROL BY THE LATCH ACTUATOR, THUS ALLOWING BOTH CAPTURE LATCH ROLLERS TO RETRACT TO THEIR OPEN POSITION.

**SERVICE IN BETWEEN FLIGHT AND MAINTENANCE CONTROL:
VISUAL INSPECTION, SERVICEABILITY CONTROL, DOCKING WITH CALIBRATING DOCKING MECHANISM.**

MAINTAINABILITY

REPAIR METHOD - REPLACEMENT.

**REFERENCE DOCUMENTS: 33U.6322.025
33U.6271.011-09 ("SOFT")
33U.6271.011-05 (PMA1)**

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE

NUMBER: M8-1SS-BM005-05
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REVISION# 1 DEC. 1996

SUBSYSTEM NAME: MECHANICAL - EDS
 LRU: GUIDE RING ASSEMBLY
 ITEM NAME: ASSEMBLY, CAPTURE LATCH

CRITICALITY OF THIS
 FAILURE MODE: 2R3

FAILURE MODE:

ROLLER FAILS TO RETURN TO INITIAL (EXTENDED) POSITION

MISSION PHASE:

OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 103 DISCOVERY
 104 ATLANTIS
 105 ENDEAVOUR

CAUSE:

MULTIPLE SPRING FAILURES DUE TO MECHANICAL/THERMAL SHOCK OR
 MANUFACTURE/MATERIAL DEFECT, JAMMED ROLLER DUE TO CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? N/A

REDUNDANCY SCREEN A) PASS
 B) FAIL
 C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS REDUNDANCY SCREEN "B" SINCE A SINGLE ROLLER FAILING TO RETURN TO ITS
 INITIAL POSITION IS NOT DETECTABLE IN FLIGHT.

C)

METHOD OF FAULT DETECTION:

NONE FOR A SINGLE ROLLER. VISUAL OBSERVATION WOULD DETECT AN INABILITY TO
 CAPTURE DUE TO BOTH ROLLERS ON SAME PEDAL FAILING TO RETURN TO THEIR
 INITIAL POSITION.

REMARKS/RECOMMENDATIONS:

EACH CAPTURE LATCH ASSEMBLY CONTAINS REDUNDANT LATCH ROLLERS, EITHER OF
 WHICH CAN ENABLE CAPTURE. EACH ROLLER MECHANISM CONTAINS A SET OF THREE
 SPRINGS TO EXTEND THE ROLLER TO ITS INITIAL (CAPTURE) POSITION. ALTHOUGH
 CAPTURE AND RING RETRACTION IS POSSIBLE, GIVEN A FAILURE OF BOTH ROLLERS ON
 ONE LATCH, IT IS QUESTIONABLE WHETHER THE TWO DOCKING MECHANISMS CAN BE
 PROPERLY ALIGNED DURING MATING FOR CLOSING THE STRUCTURAL HOOKS.

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- FAILURE EFFECTS -

(A) SUBSYSTEM:

NO EFFECT FIRST FAILURE. A FAILURE OF A SPRING ON ONE ROLLER MECHANISM ACCOMPANIED WITH FAILURE OF A SPRING ON A SECOND MECHANISM WOULD PREVENT EITHER LATCH ROLLER FROM RETURNING TO IT'S INITIAL POSITION ONCE INITIAL CONTACT IS MADE WITH THE OPPOSING BODY MOUNTED LATCH ON THE ISS DOCKING MECHANISM. A FAILURE OF SECOND LATCH ROLLER TO RETURN TO IT'S INITIAL EXTENDED (CLOSED) POSITION MAY ALLOW CAPTURE TO OCCUR BUT RING ALIGNMENT FOR STRUCTURAL MATING OF THE INTERFACE WOULD BE IMPOSSIBLE.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT ON INTERFACING SUBSYSTEMS.

(C) MISSION:

NO EFFECT FIRST FAILURE. SIMILAR FAILURE OF SECOND ROLLER ON AFFECTED CAPTURE LATCH ASSEMBLY WILL RESULT IN LOSS OF DOCKING CAPABILITIES.

(D) CREW, VEHICLE, AND ELEMENT(S):

NO EFFECT ON CREW AND VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST ROLLER FAILURE - NO EFFECT, REDUNDANT ROLLER WILL ENABLE CAPTURE.
SECOND ROLLER FAILURE - INABILITY OF ONE CAPTURE LATCH ON ORBITER/PMA1 DOCKING MECHANISM TO LATCH TO IT'S OPPOSING BODY MOUNTED LATCH ON THE ISS DOCKING MECHANISM. ALTHOUGH CAPTURE AND RING RETRACTION IS POSSIBLE IT IS QUESTIONABLE WHETHER THE TWO DOCKING MECHANISMS CAN BE PROPERLY ALIGNED DURING MATING FOR CLOSING THE STRUCTURAL HOOKS. WORST CASE, LOSS OF DOCKING RESULTING IN LOSS OF ORBITER (PMA1)/ISS MISSION OBJECTIVES.

DESIGN CRITICALITY (PRIOR TO OPERATIONAL DOWNGRADE, DESCRIBED IN F): N/A

(F) RATIONALE FOR CRITICALITY CATEGORY DOWNGRADE:

N/A (THERE ARE NO WORKAROUNDS TO CIRCUMVENT THIS FAILURE.)

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS TO MINUTES

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: N/A

IS TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT?
N/A

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

THERE IS NO CORRECTIVE ACTION TO FOLLOWING SECOND FAILURE OTHER THAN TO ABORT MISSION.

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PASSIVE MECHANISM)****HAZARDS REPORT NUMBER(S): NONE****HAZARD(S) DESCRIPTION:**

N/A

-DISPOSITION RATIONALE-

(A) DESIGN:

EACH CAPTURE LATCH ASSEMBLY CONTAINS REDUNDANT LATCH ROLLERS, EITHER OF WHICH CAN ENABLE CAPTURE. EACH ROLLER MECHANISM CONTAINS A SET OF THREE SPRINGS TO EXTEND THE ROLLER TO IT'S INITIAL (CAPTURE) POSITION. THE CAPTURE LATCH ASSEMBLY IS COMPLETELY ENCASED TO PREVENT INTRODUCING CONTAMINATION LARGE ENOUGH TO CAUSE A JAMMING.

(B) TEST:

REFER TO "APPENDIX B" FOR DETAILS OF THE FOLLOWING ACCEPTANCE AND QUALIFICATION TESTS OF THE DOCKING MECHANISMS RELATIVE TO THIS FAILURE MODE.

DOCKING MECHANISM ACCEPTANCE TESTS:

1. AXIAL STIFFNESS IN INITIAL POSITION LOAD TEST
2. RETRACTION FORCE LOAD TEST
3. RESTRAINING FORCE LOAD TEST
4. BODY LATCH LOAD TEST
5. CAPTURE LATCH FORCE LOAD TEST
6. VIBRATION TEST
7. THERMAL VACUUM TEST

DOCKING MECHANISM QUALIFICATION TESTS:

1. TRANSPORTABILITY STRENGTH TEST
2. VIBRATION TEST
3. SHOCK-BASIC DESIGN TEST
4. THERMAL VACUUM TEST
5. SIX-DEGREE-OF-FREEDOM TEST
6. SERVICE LIFE TEST
7. DISASSEMBLY INSPECTION

OMRSD - TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

COMPONENTS ARE SUBJECTED TO A 100% RECEIVING INSPECTION PRIOR TO INSTALLATION.

CONTAMINATION CONTROL

CORROSION PROTECTION PROVISIONS AND CONTAMINATION CONTROL VERIFIED BY INSPECTION. CHECK OF ROOM CLEANLINESS; PARTS WASHING AND OTHER OPERATIONS OF THE TECHNOLOGICAL PROCESS WHICH PROVIDES CLEANLINESS ARE VERIFIED BY INSPECTION.

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CRITICAL PROCESSES
ANODIZING, HEAT TREATING, SOLDERING, CHEMICAL PLATING, AND CURING VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
TORQUE, ADJUSTMENTS AND TOLERANCES ACCORDING TO TECHNICAL REQUIREMENTS OF THE DRAWINGS ARE VERIFIED BY INSPECTION.

TESTING
ATP/QTP TESTING VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING/PACKAGING PROCEDURES AND REQUIREMENT FOR SHIPMENT VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
DATA ON TEST FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING OF ODS DOCKING MECHANISMS CAN BE FOUND IN PRACA DATA BASE.

(E) OPERATIONAL USE:
NONE. REDUNDANT LATCH ROLLER WILL PROVIDE CAPTURE.

- APPROVALS -

PRODUCT ASSURANCE ENGR. :
DESIGN ENGINEER :
NASA SS/MA :
NASA SUBSYSTEM MANAGER :
JSC MOD :

M. NIKOLAYEVA
E. BOBROV

[Handwritten signatures and initials over approval lines]